CLAIMS

What is claimed is:

1. A system, comprising:

a holographic optical element (HOE) device having:

a first element having first and second surfaces, the first surface being positionable to face incident light rays;

an emulsion material disposed over the second surface of the first element and having a recorded interference pattern thereon; and

a second element having a first surface disposed over the emulsion material, the second element being structured to pass resulting light rays, derived from the incident light rays diffracted by the recorded interference pattern, in a direction towards a location facing a second surface of the second element; and

an optical processing unit to receive the resulting light rays passed by the second element.

2. The system of claim 1, further comprising a transmitter unit disposed at least in part behind the second surface of the second element.

3. The system of claim 2 wherein the emulsion material is shaped to provide an opening through which to pass a light signal sent from the transmitter unit.

4. The system of claim 2 wherein the transmitter unit comprises:

an optical fiber capable to provide a light signal;

a first and a second optical element to expand the light signal provided by the optical fiber;

a third optical element to control divergence of the expanded light signal; and

a fourth optical element to collimate light that exits from the transmitter unit.

5. The system of claim 1, further comprising a plurality of mirrors positionable between the HOE device and the optical processing unit, the plurality of mirrors being capable to reduce an overall focal length of the HOE device by controlling a direction of the resulting light rays passed from the second element of the HOE device.

6. The system of claim 1, further comprising a steering mirror positionable between the HOE device and the optical processing unit, the steering mirror being capable of substantially keeping the resulting light rays focused towards the optical processing unit in response to movement of the HOE device.

7. The system of claim 1, further comprising:

an optical detector; and

a beam splitter to direct a first portion of the resulting light rays associated with a tracking operation towards the optical detector and to direct a second portion of the resulting light rays having data modulated thereon towards the optical processing unit.

8. The system of claim 1, further comprising:

a collimating optical assembly positionable between the HOE device and the optical processing unit to collimate the resulting light rays; and

an optical element positionable between the collimating optical assembly and the optical processing unit to separate, from the collimated resulting light rays, a tracking channel and a communication channel, and to direct the communication channel towards the optical processing unit.

9. The system of claim 8 wherein the collimating optical assembly includes a movable refocusing element to longitudinally refocus the collimated resulting light rays.

10. The system of claim 9 wherein the refocusing element is movable via motor control.

11. The system of claim 8 wherein the collimating optical assembly includes a plurality of lenses to correct aberrations in the resulting light rays.

12. The system of claim 8 wherein the optical element comprises a monolithic optical element, the monolithic optical element including:

a lens to refract the resulting light rays;

a first element, coupled to the lens and coupled to a second element at an interface, to receive the refracted light rays from the lens;

a beam splitter disposed at the interface between the first and second element to direct the refracted light rays to the tracking channel and to the communication channel; and

a third element coupled to the second element, the third element having a reflective surface to reflect the refracted light rays of the communication channel towards the optical processing unit.

13. The system of claim 1 wherein the optical processing unit includes a photodetector to convert the resulting light rays received from the second element into electronic signals.

14. The system of claim 1 wherein the recorded interference pattern comprises a volume phase hologram.

15. The system of claim 1, further comprising a spotting scope usable for alignment adjustment of the HOE device.

16. The system of claim 15 wherein the emulsion material is shaped to provide a substantially unobstructed field-of-view for the spotting scope.

17. The system of claim 15 wherein the spotting scope is disposed at least in part behind the second surface of the second element.

18. The system of claim 15 wherein the spotting scope includes an image sensor.

19. The system of claim 1, further comprising an alignment beacon.

20. The system of claim 19 wherein the emulsion material is shaped to provide a substantially unobstructed opening for the alignment beacon.

21. The system of claim 19 wherein the alignment beacon is disposed at least in part behind the second surface of the second element.

22. The system of claim 19 wherein the alignment beacon is capable of being provided along with a transmit light signal along a same optical fiber.

23. An apparatus, comprising:

a holographic optical element (HOE) device disposed in a receiver unit, the HOE device including a recorded interference pattern, the HOE device being positionable to face incident light rays and being capable of passing the incident light rays as resulting light rays diffracted by the recorded interference pattern.

24. The apparatus of claim 23, further comprising a transmitter unit disposed at least in part behind the HOE device.

25. The apparatus of claim 23 wherein the receiver unit includes:

an optical processing unit to receive the resulting light rays; and

a plurality of mirrors between the optical processing unit and the HOE device to control a direction of the resulting light rays from the HOE device to the optical processing unit.

26. The apparatus of claim 23, further comprising:

a collimating optical assembly positionable between the HOE device and an optical processing unit to collimate the resulting light rays; and

an optical element positionable between the collimating optical assembly and the optical processing unit to separate, from the collimated resulting light rays, a tracking channel and a communication channel, and to direct the communication channel towards an optical processing unit.

27. The apparatus of claim 26 wherein the optical element comprises a monolithic optical element, the monolithic optical element including:

a lens to refract the resulting light rays;

a first element, coupled to the lens and coupled to a second element at an interface, to receive the refracted light rays from the lens;

a beam splitter disposed at the interface between the first and second element to direct the refracted light rays to the tracking channel and to the communication channel; and

a third element coupled to the second element, the third element having a reflective surface to reflect the refracted light rays of the communication channel towards an optical processing unit.

28. The apparatus of claim 24, further comprising an emulsion material having the interference pattern recorded thereon, wherein the emulsion material is shaped to provide an opening through which to pass a light signal sent from the transmitter unit.

29. The apparatus of claim 23, further comprising a spotting scope disposed at least in part behind the HOE device.

30. The apparatus of claim 23, further comprising an alignment beacon.

31. The apparatus of claim 23, further comprising an emulsion material having the interference pattern recorded thereon, wherein the emulsion material is shaped

to provide a center obscuration to allow the HOE device to collect the incident light rays into a cone.

32. An apparatus, comprising:

a holographic optical element (HOE) device disposed in a receiver unit, the HOE device including an interference pattern recorded on an emulsion material; and

a transmitter unit disposed at least in part behind the HOE device, the emulsion material being shaped to allow transmission of a light signal from the transmitter unit through the HOE device, substantially unaffected by the recorded interference pattern.

33. The apparatus of claim 32 wherein the transmitter unit comprises:

an optical fiber capable to provide the light signal;

a first and a second optical element to expand the light signal provided by the optical fiber;

a third optical element to control divergence of the expanded light signal; and

a fourth optical element to collimate light that exits from the transmitter unit.

34. The apparatus of claim 32, further comprising a spotting scope usable for alignment adjustment.

35. The apparatus of claim 34 wherein the emulsion material is shaped to provide a substantially unobstructed field-of-view for the spotting scope.

36. The apparatus of claim 34 wherein the spotting scope is disposed at least in part behind the HOE device.

37. The apparatus of claim 34 wherein the spotting scope includes an image sensor.

38. The apparatus of claim 32, further comprising an alignment beacon.

39. The apparatus of claim 38 wherein the alignment beacon is disposed at least in part behind the HOE device, and wherein the emulsion material is shaped to provide a substantially unobstructed opening for the alignment beacon.

40. The apparatus of claim 38 wherein the alignment beacon is capable of being provided with the light signal from the transmitter unit along a same optical fiber.

41. The apparatus of claim 32 wherein the emulsion material is shaped to provide a region devoid of emulsion material, wherein the region allows a substantially unobstructed passage of the light signal from the transmitter unit and a substantially unobstructed field-of-view of a spotting scope disposed at least in part behind the HOE device.

42. A method, comprising:

positioning a transmitter unit at least in part behind a holographic optical element (HOE) device including an interference pattern recorded on an emulsion material, the part of the transmitter unit being positioned behind an opening in the emulsion material; and

transmitting a light signal from the transmitter unit through the opening in the emulsion material, the transmitted light signal being substantially unaffected by the recorded interference pattern.

43. The method of claim 42, further comprising using a spotting scope in connection with alignment adjustment related to the transmitted light signal.

44. The method of claim 42, further comprising using an alignment beacon in connection with alignment adjustment related to light rays incident on the HOE device.